Implementing UAS-based LiDAR for High Resolution Data Capture

SKYTEC AERIAL DATA SPECIALISTS

May 17, 2018

Unmanned Aerial Systems (UAS) – THE BIG PICTURE

- Predicted 2.7 million commercial UAS' in the air by 2020
- Most common utilization is photography
- "Wild West" – data acquisition and results are varying
- Best practices and new standards are rapidly emerging

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What can UAS technology do for stream and ecological applications?

- High accuracy data from multiple sensors
- Significant cost-savings ***and*** ROI
- Reduce safety risks for personnel or manned aviation pilots
- Easily deployed and repeatable flight patterns - enhanced change detection
- Data can be quickly processed and shared into GIS or CAD software packages

Emergence of UAS Mapping Solutions

- Advanced through development in
  - GPS/GNSS enhancements
  - Onboard telemetry/inertial measurement units
  - Sensor size reduction
- Commercial airspace authorizations
  - FAA section 333
  - Part 107
- Larger trends towards:
  - “Internet of Things”
  - “Sensor fusion”

Completing the Data Portfolio

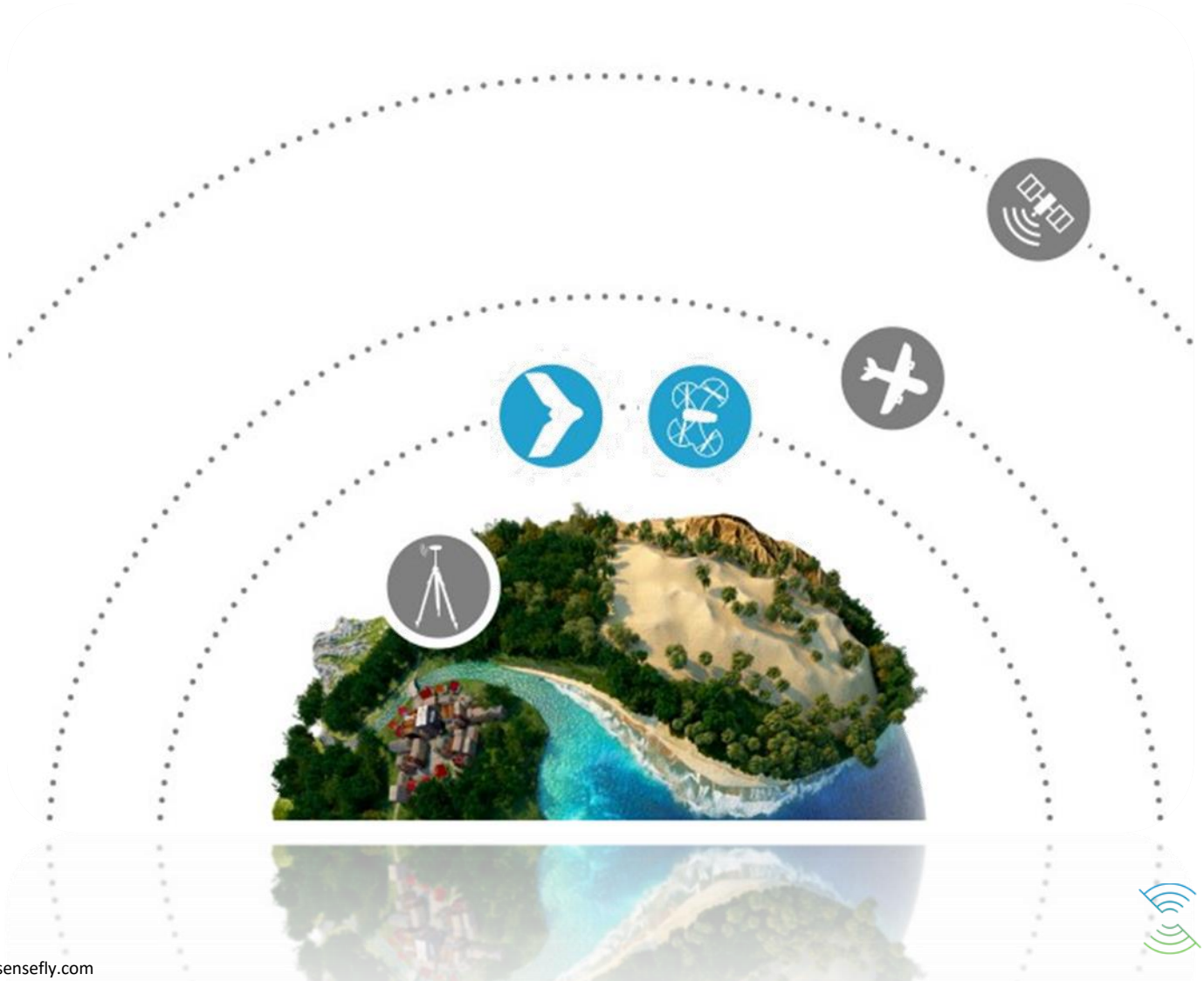

Image courtesy https://www.sensefly.com

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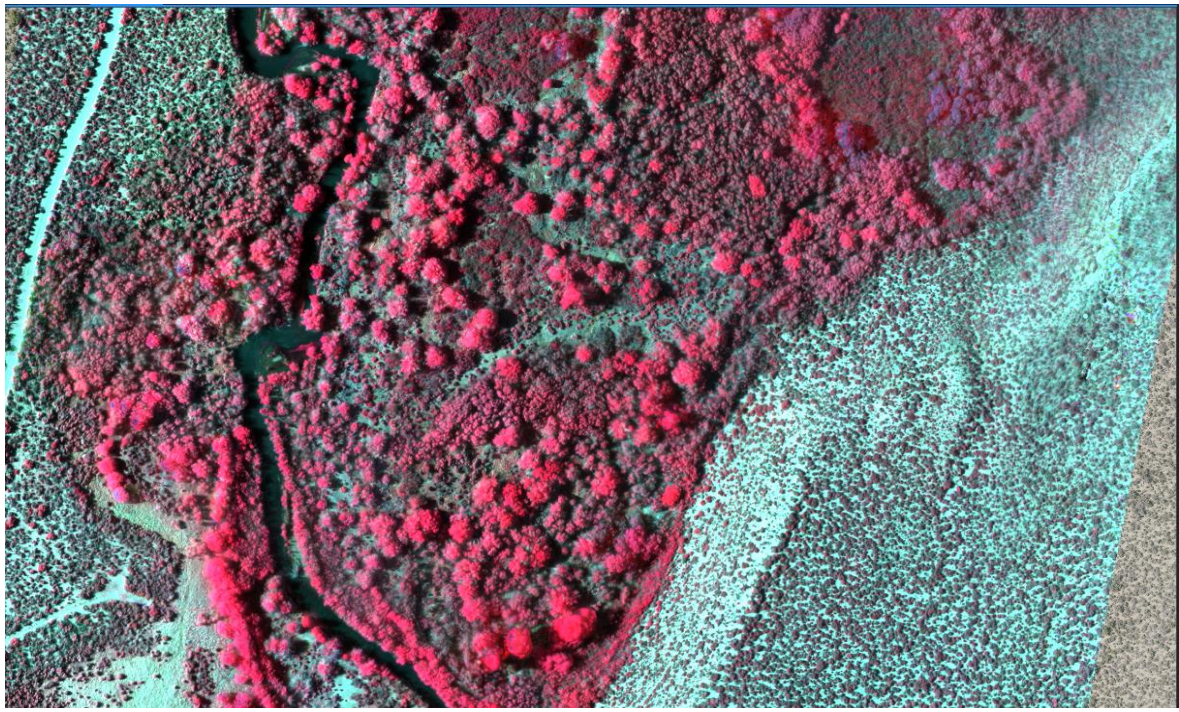
UAS Enhanced Field Survey Best Practices

- Always establish ground control and check points
- 2-person flight crew
  - Pilot in Command
  - Visual Observer
- Always bring backup system
- Always validate data capture
- Lots of data storage space

UAS Data Capabilities

- USGS-ASPRS Quality Level 0 – 1 terrain products
- Very high resolution image data; 1”-2” common
- Extract or assign attributes by spectral signatures or 3D attributes



Remote Sensing Refresher:
Fundamental Difference Between Sensor Tech

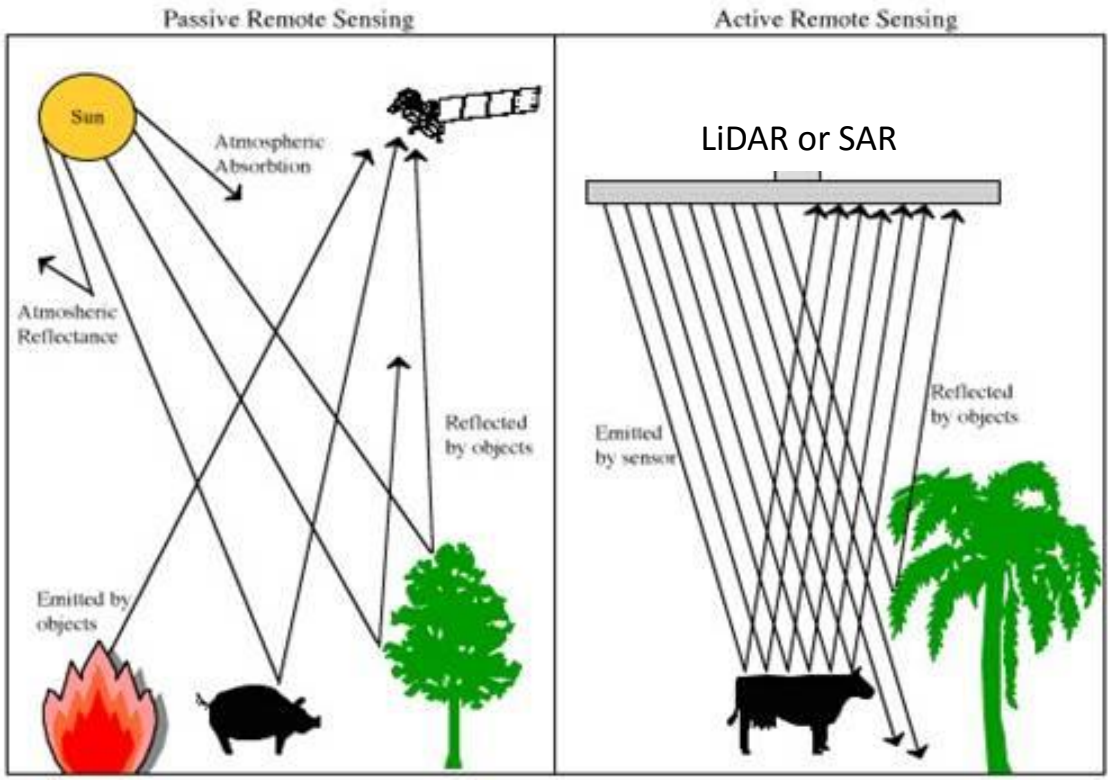
Passive Sensors

- Absorb or measure energy

"Get what you see"

Active Sensors

- Emit and measure energy
- Saturate areas that usually would not reflect or emit
- If a photon can reach it you can measure XYZ



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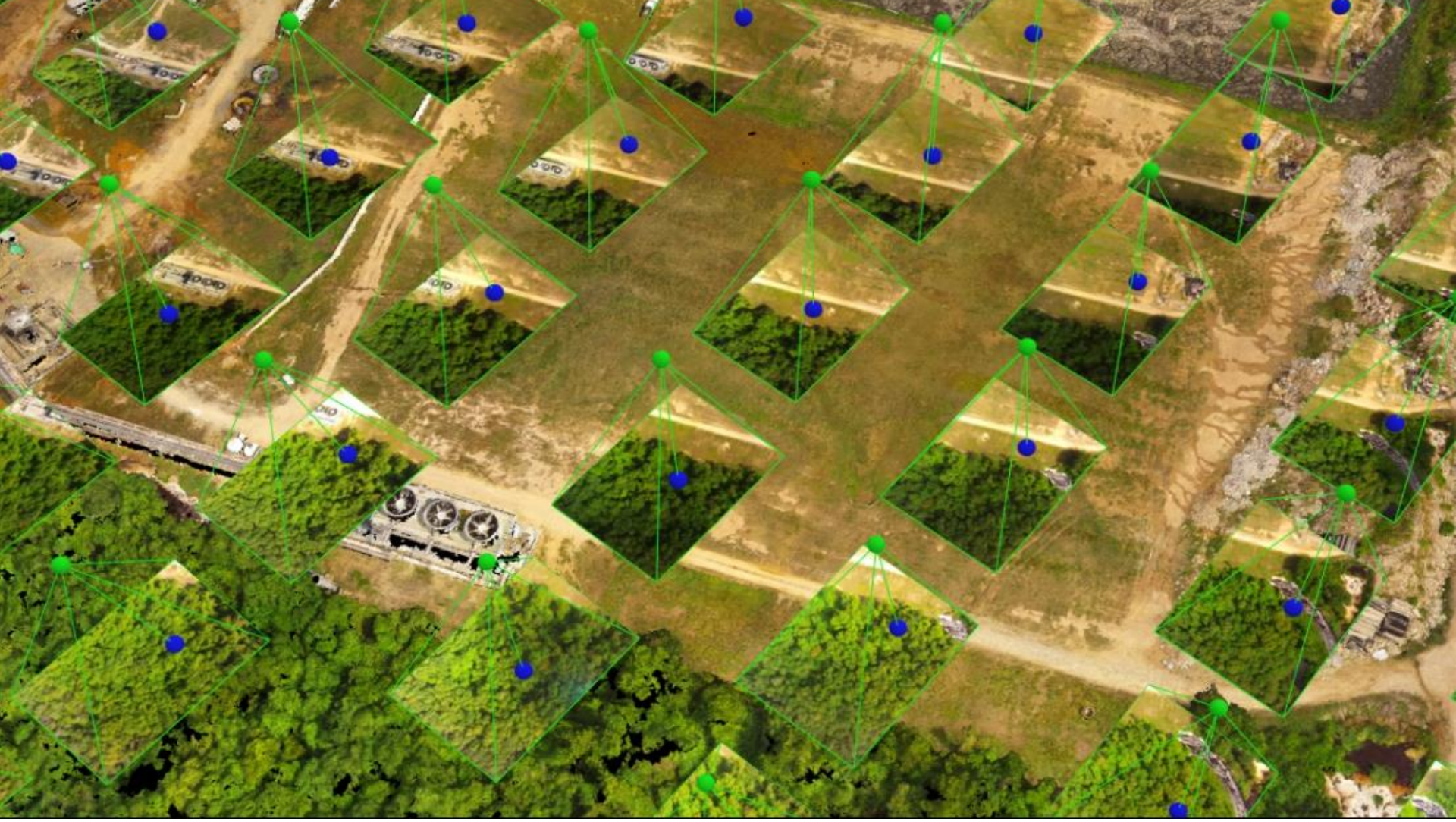
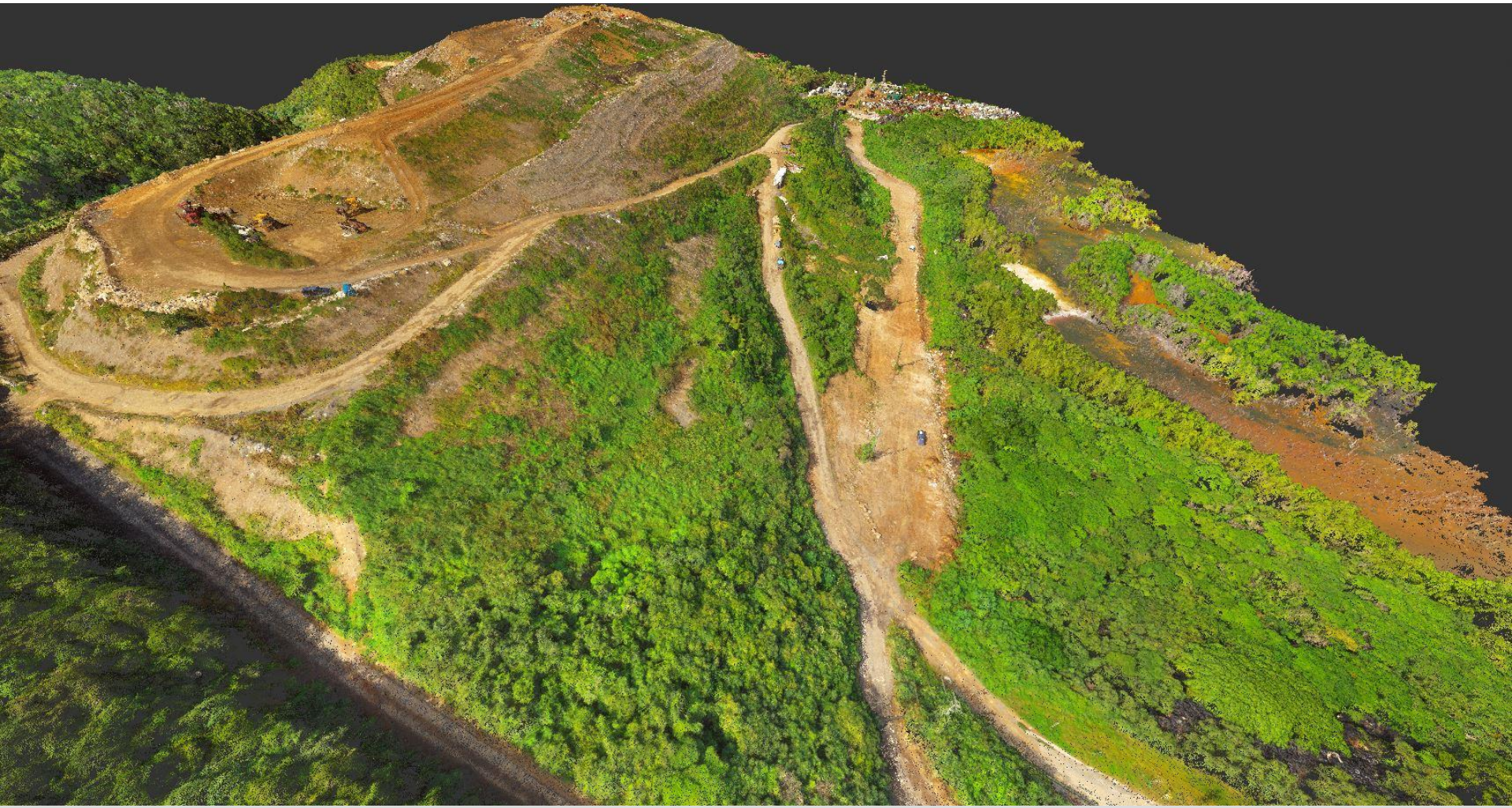


Photogrammetry

Photogrammetric Point Cloud: Heavy Ground Cover



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Photogrammetry Limitations: Voids

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Photogrammetry Limitations: Voids

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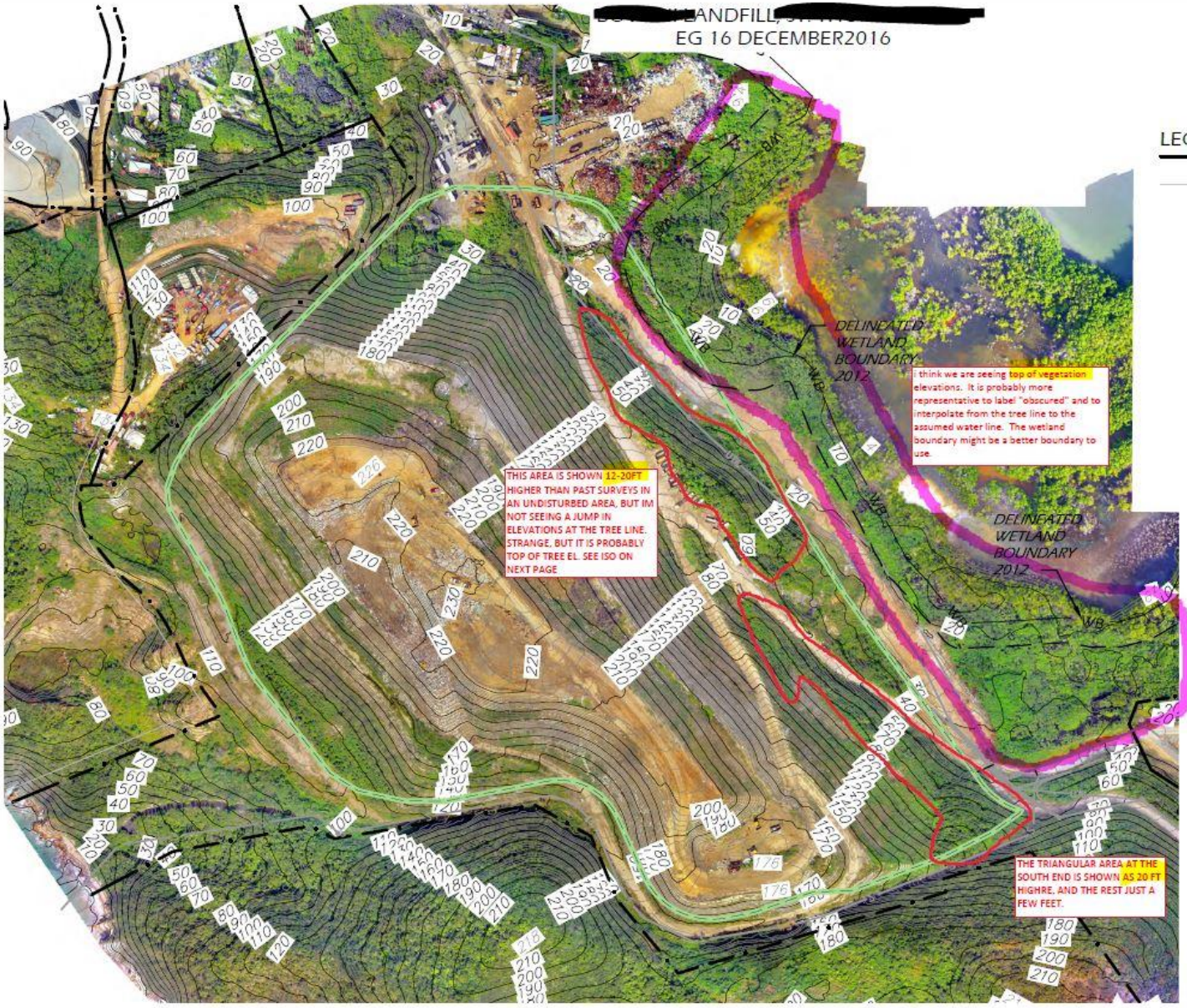

LEGEND

30 — EXISTING GROUND ELEVATION (FEET)

[redacted]
PHONE: [redacted]
FAX:

DATE:	2/3/17	SCALE:	1" = 200'
PROJECT NO.	13-2422-63B	FILE NO.	15-3697F07007
DOCUMENT NO.		FIGURE NO.	2

LiDAR Acquisition: Ground Surface Capture

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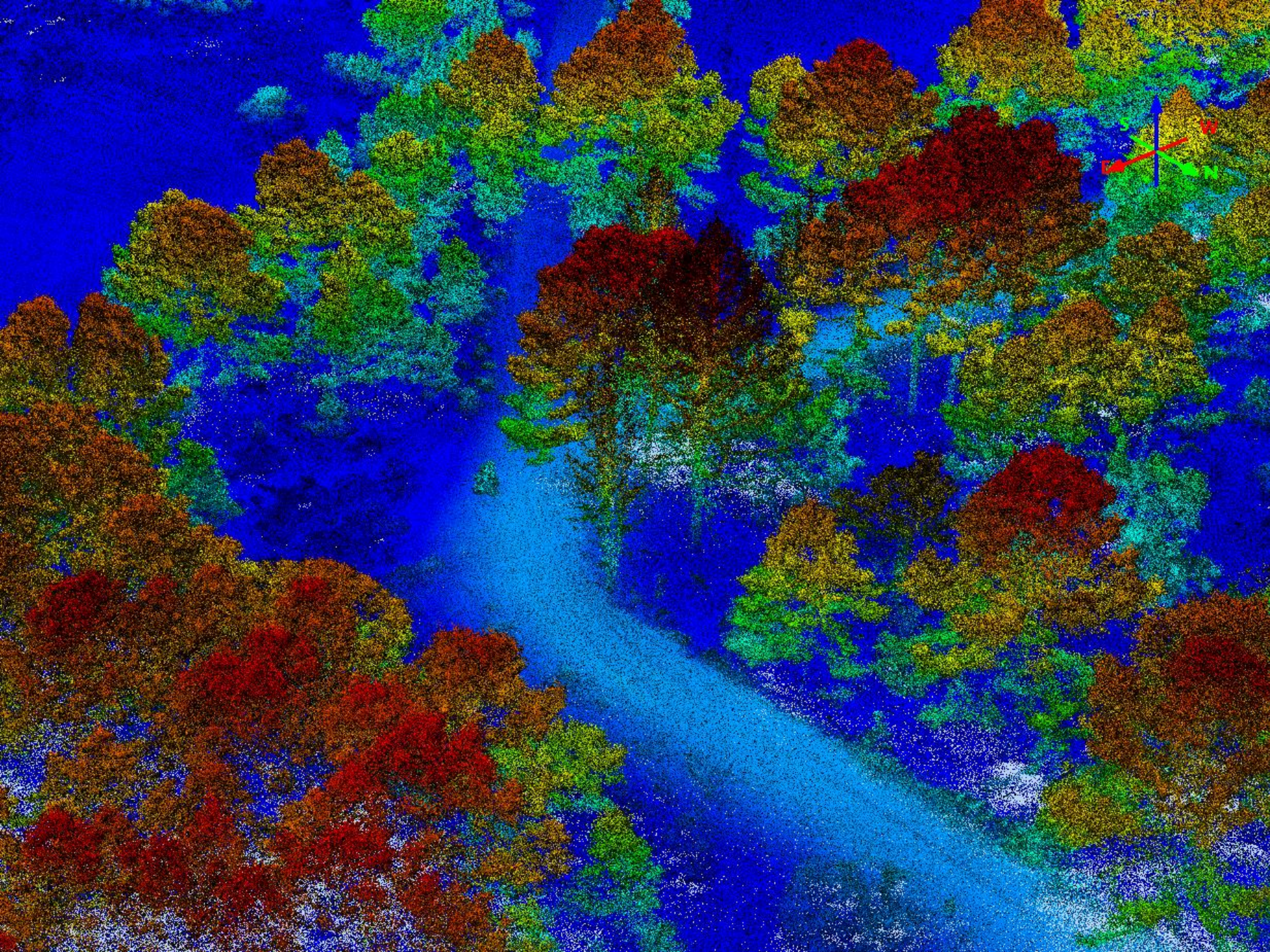
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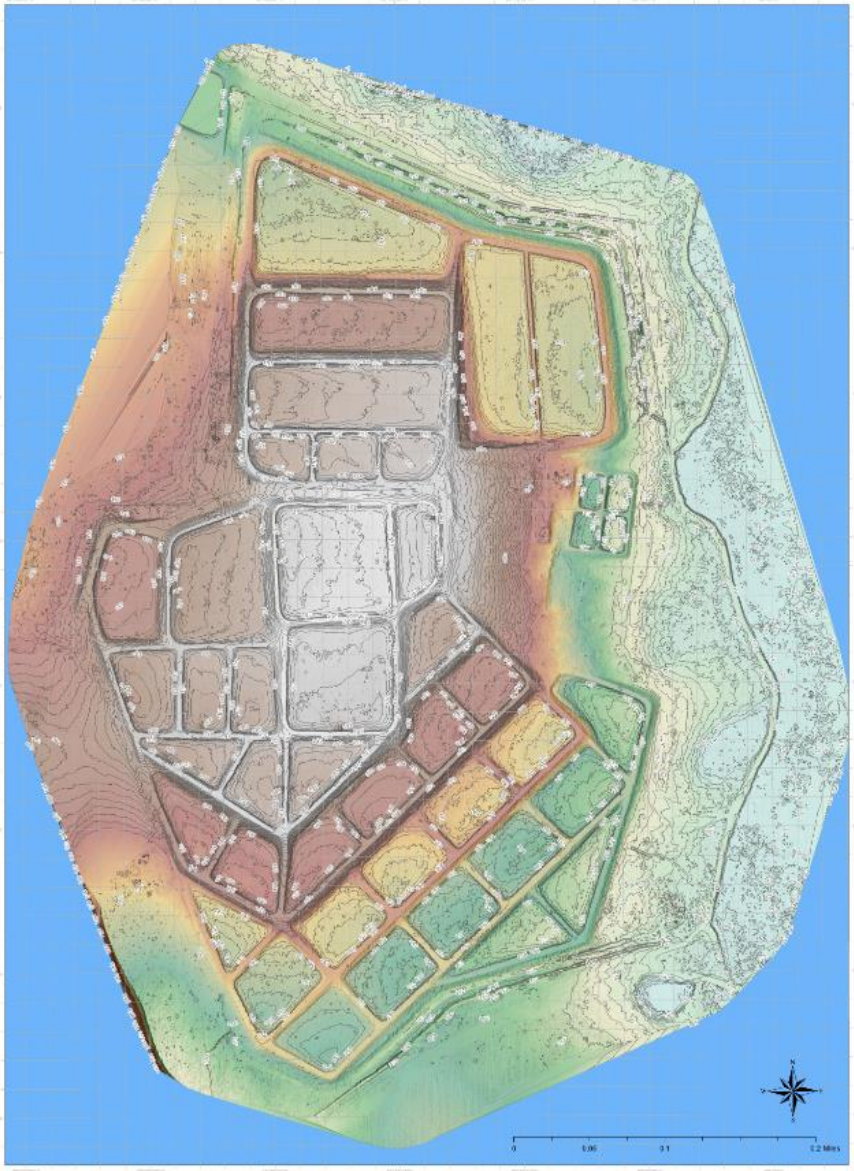
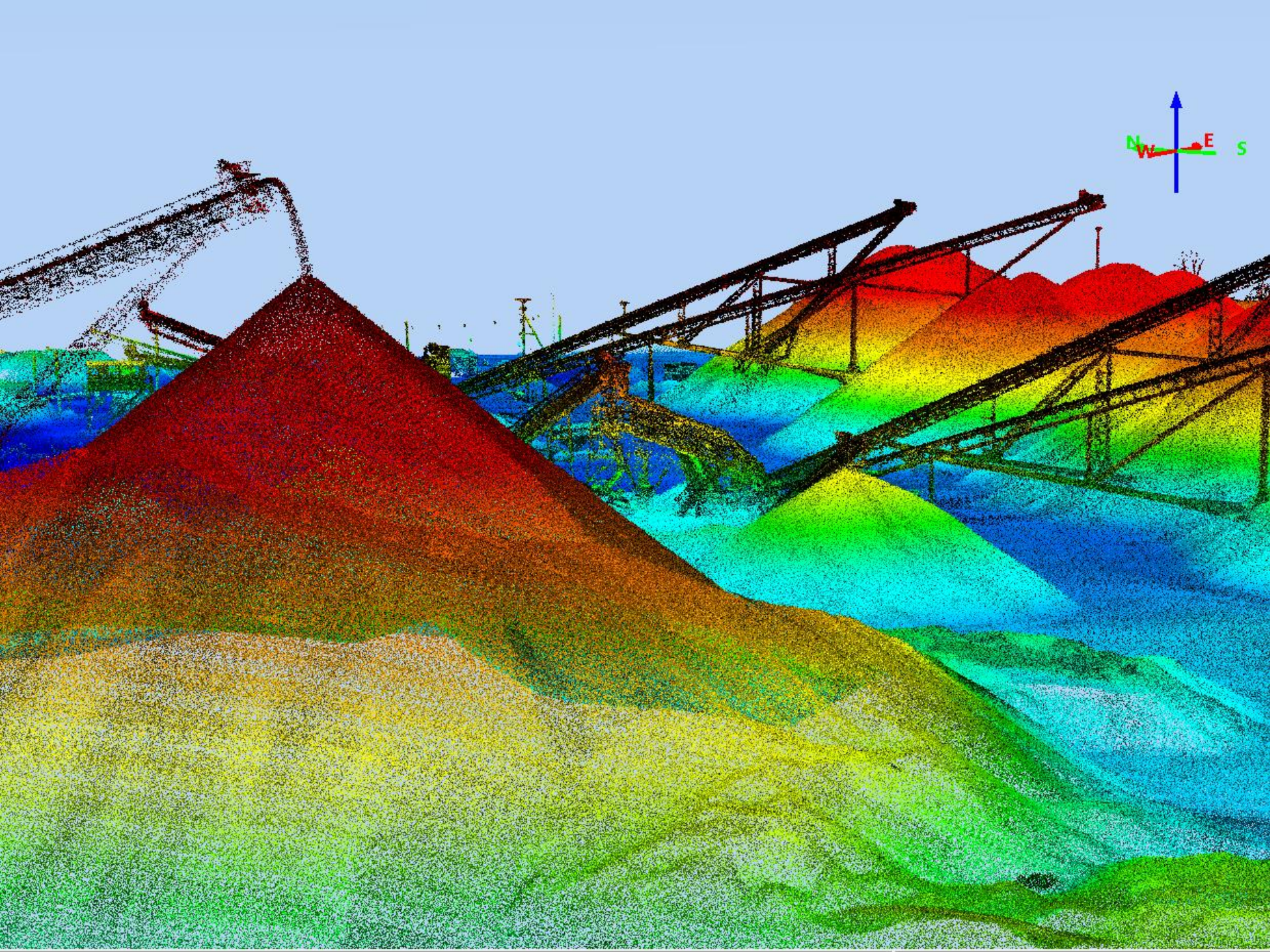


ENVIRONMENTAL SERVICES, INC.

30 Years of Excellence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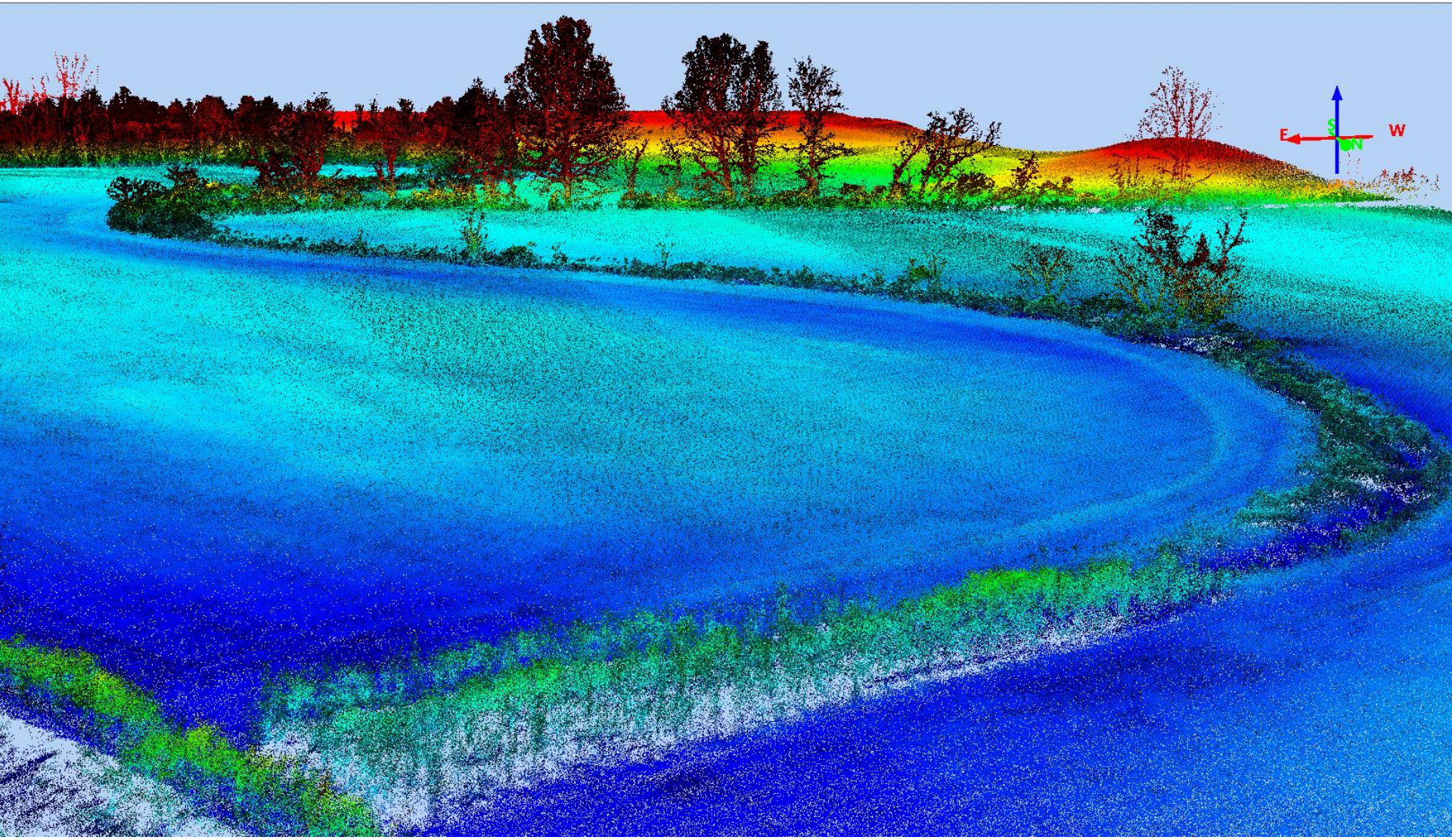
LiDAR Requires Heavy Lift Systems

- Altus LRX2 and ORC2
- Capable of lifting LiDAR and multi-payload combinations
- Redundant control and safety systems
- Increased flight durations

Case Studies

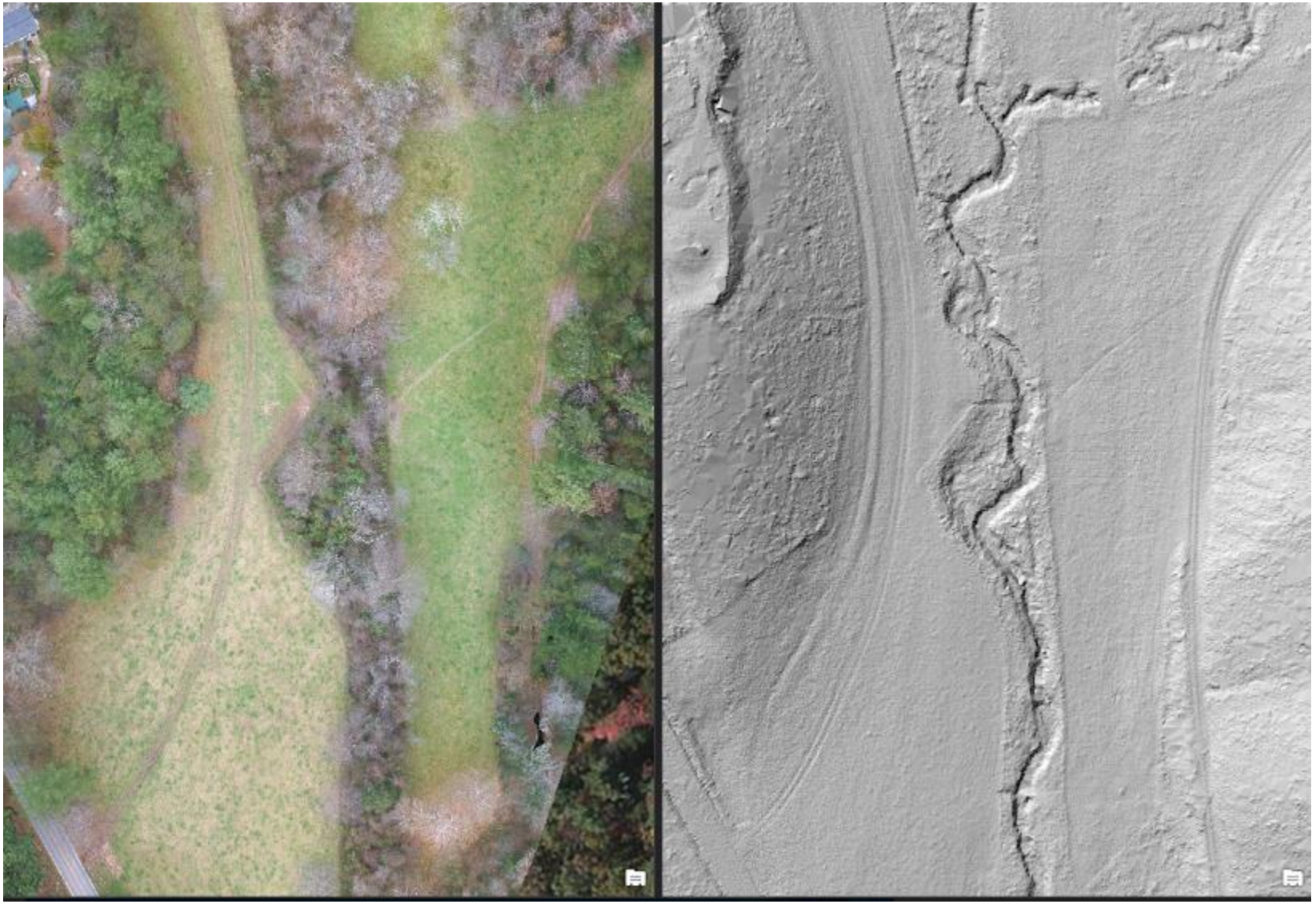
- 12,000 linear feet of riparian corridor – 8 stream segments
- 28 survey control points
- 2”-resolution imagery – horizontal RMSE = 0.016’ – 0.014’
- LiDAR point cloud ground classified – vertical RMSE 0.064’ – 0.204’
- 38,659,345 points, spacing of 0.13’
- USGS/ASPRS Quality Level 0 data

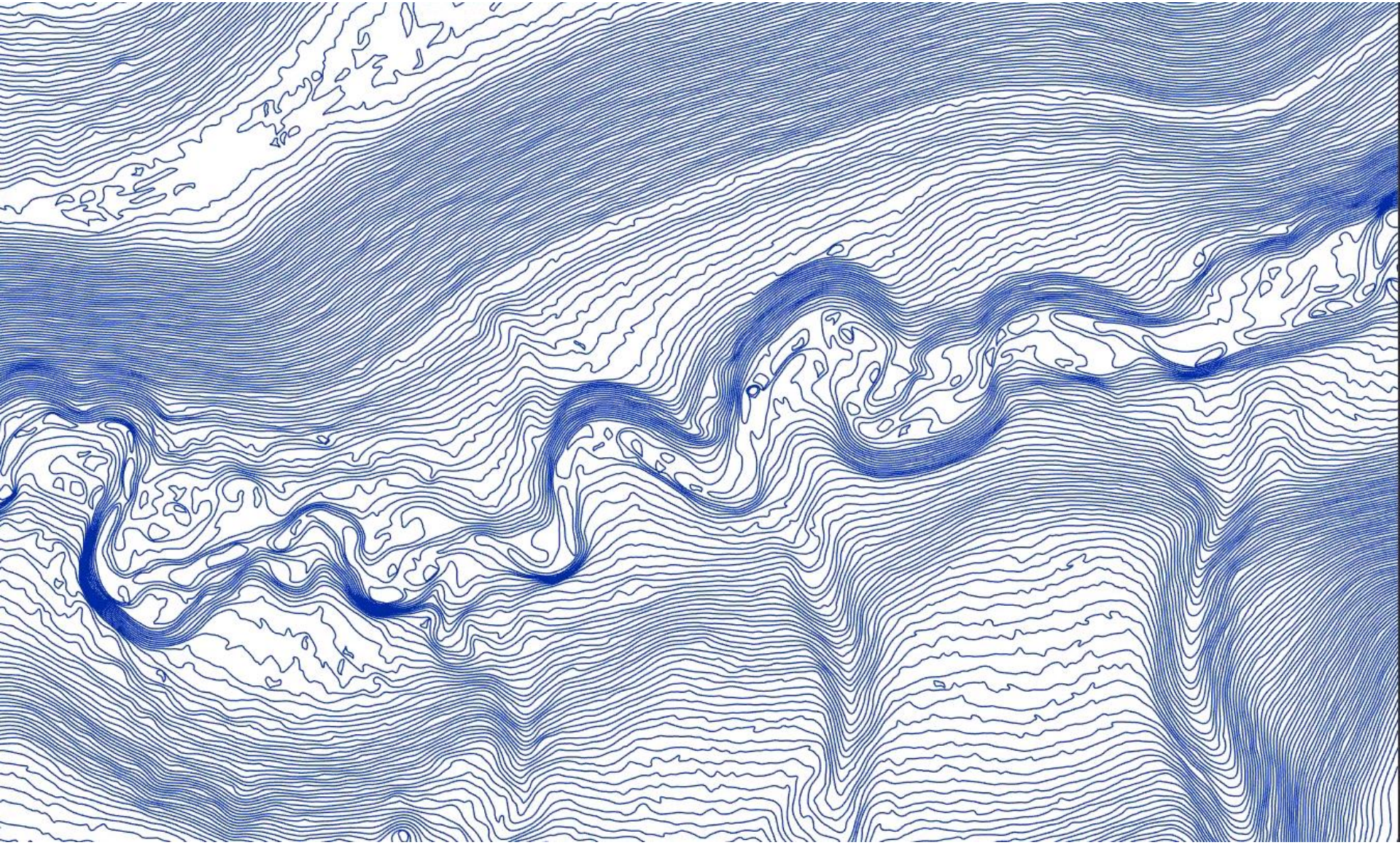


ANCHOR QEA

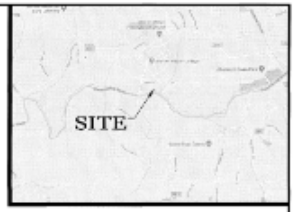
High Resolution Imagery Captured

Terrain Elevation Surface Developed





GENERAL NOTES



LOCATION MAP
NOT TO SCALE

RESTORATION SYSTEMS | LLC

Hayes | James
ENGINEERS, PLANNERS & SURVEYORS
3630 EAST FIRST STREET
SUITE 1
BLUE RIDGE, GEORGIA 30513
TEL: (706) 632-4901
FAX: (706) 632-4962

TOPOGRAPHIC WORKSHEET
FOR

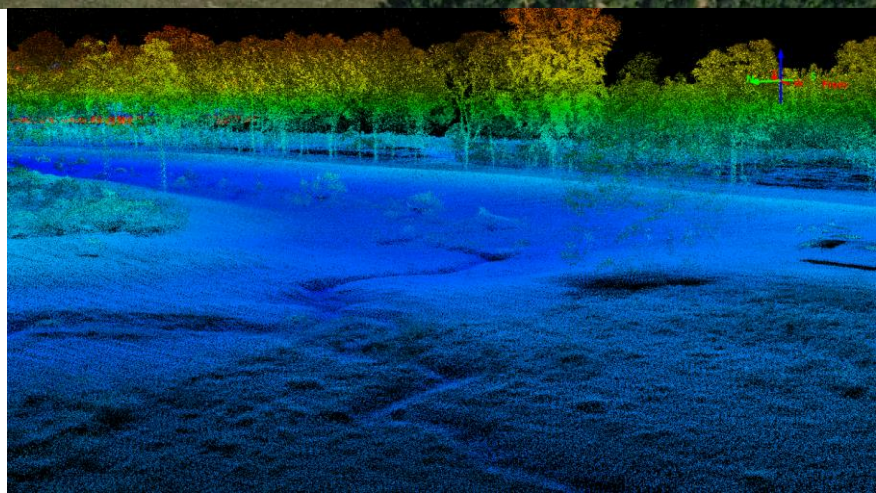
AREA 4A NORTH
WARREN WILSON
COLLEGE

PROJECT LOCATION
Township: Buncombe
County: Buncombe
State: North Carolina

Project No. 17-086
Drawn By: BJW
Checked By: BWH
Scale: 1"=50'
Date: 12/19/17

Sheet Number
1 of 6

Stream Mitigation Bank Monitoring



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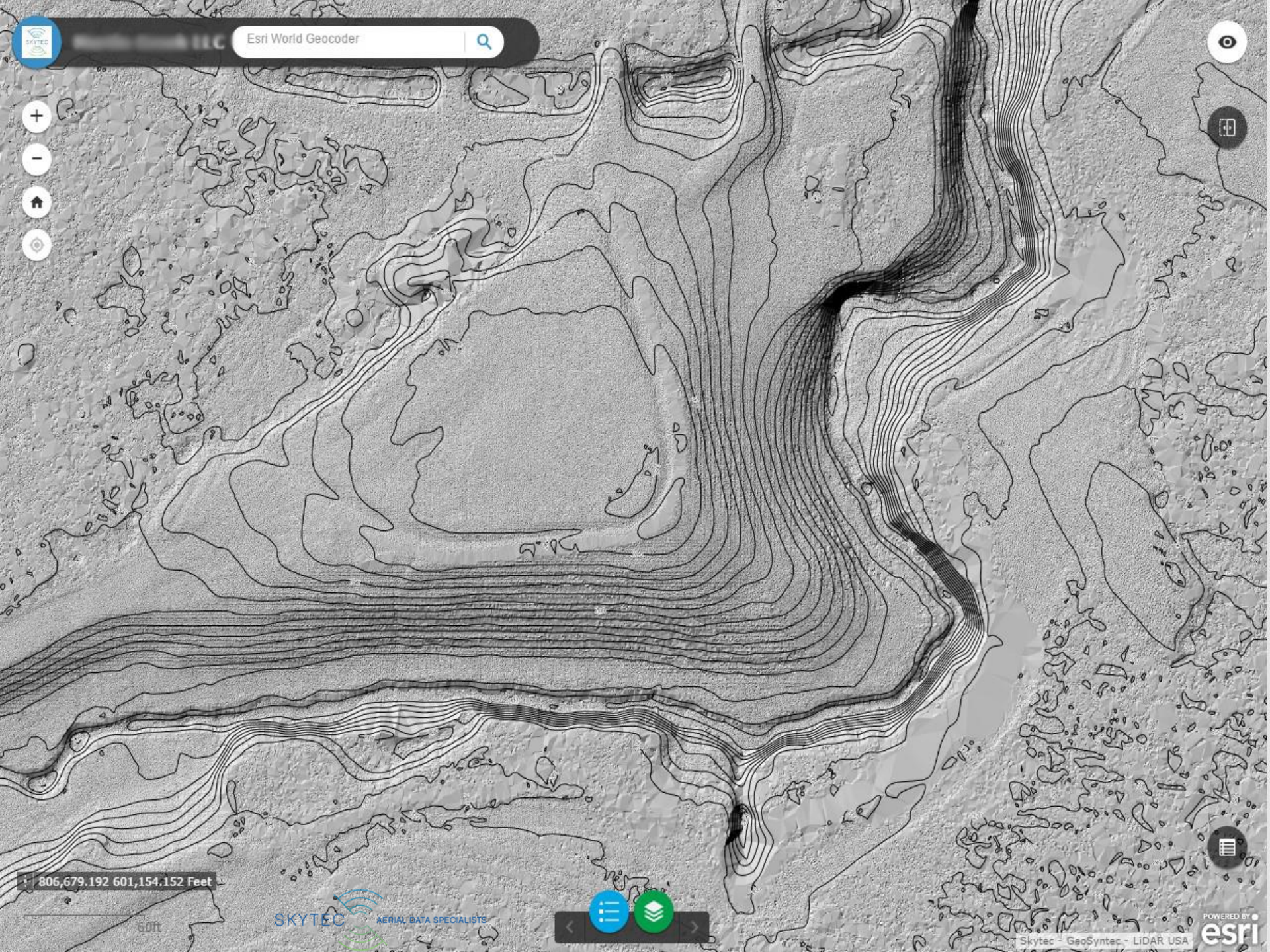
Esri World Geocoder
806,679.192 601,154.152 Feet
60ft
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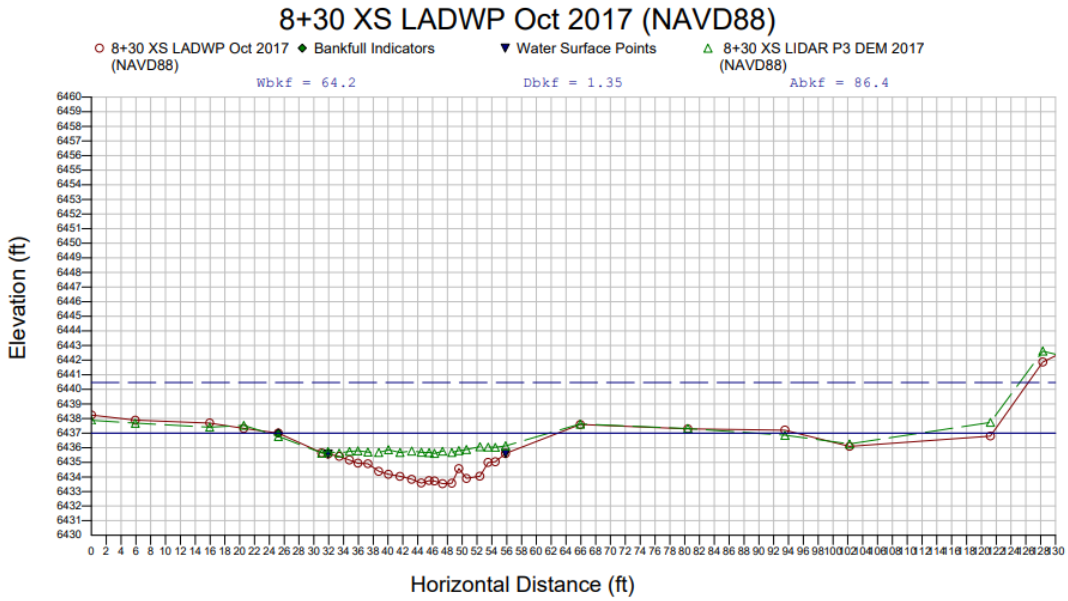
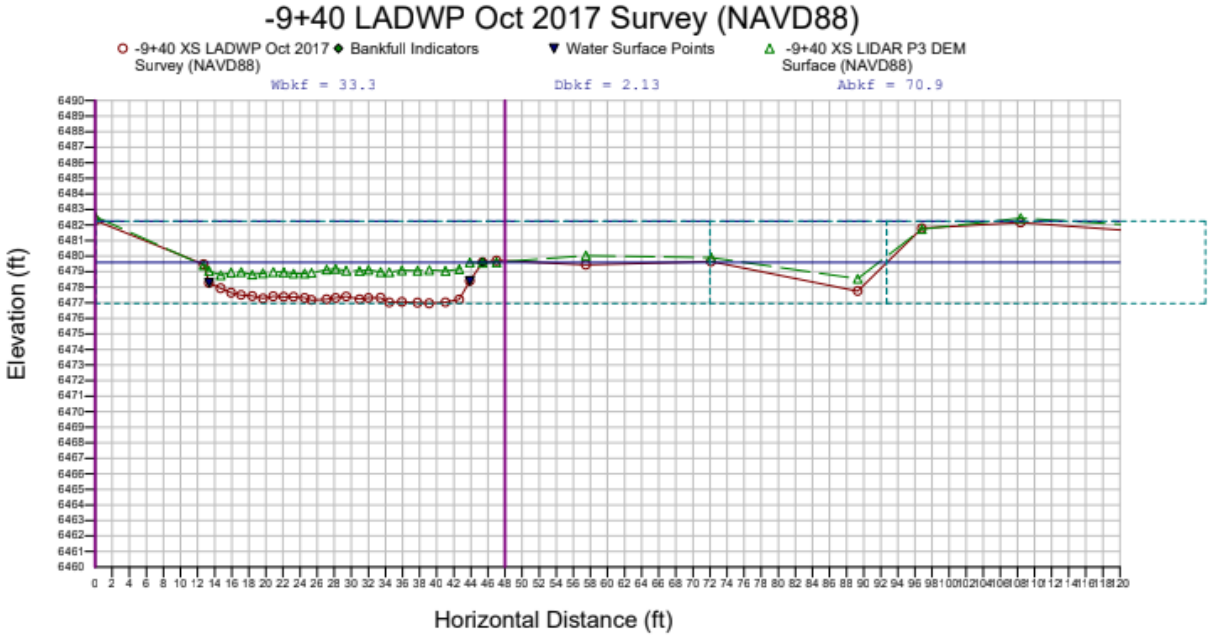
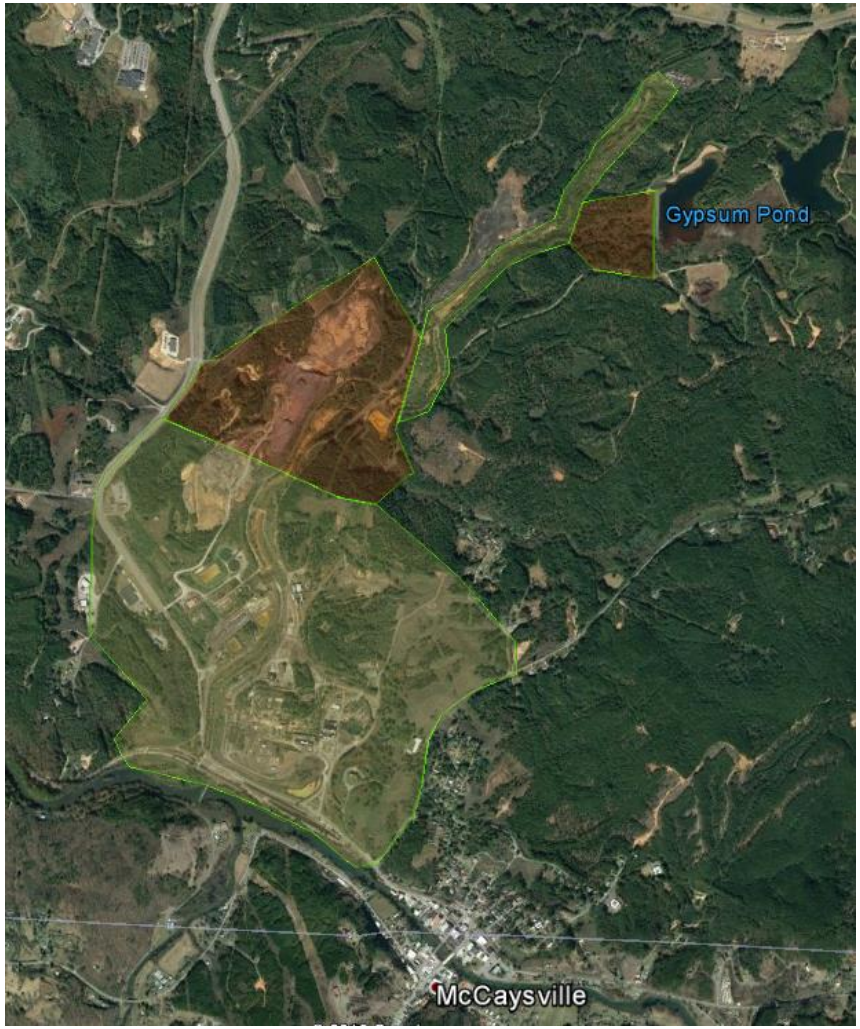
AERIAL DATA SPECIALISTS
Skytec - GeoSyntec - LiDAR USA
POWERED BY esri


8+30 XS LADWP Oct 2017 (NAVD88)
8+30 XS LADWP Oct 2017 (NAVD88)
Bankfull Indicators
Water Surface Points
8+30 XS LIDAR P3 DEM 2017 (NAVD88)
Wbkf = 64.2
Dbkf = 1.35
Abkf = 86.4
Elevation (ft)
Horizontal Distance (ft)


-9+40 LADWP Oct 2017 Survey (NAVD88)
-9+40 XS LADWP Oct 2017 Survey (NAVD88)
Bankfull Indicators
Water Surface Points
-9+40 XS LIDAR P3 DEM Surface (NAVD88)
Wbkf = 33.3
Dbkf = 2.13
Abkf = 70.9
Elevation (ft)
Horizontal Distance (ft)

Copperhill Case Study

- Objective: Generate digital elevation model to delineate sub-watersheds) and local catchments (~2,000-acres) at former copper mine and NPL site
- Produce 1’ elevation contours for ground terrain and .6” DEM
- Test Riegl VUX-1 sensor for feasibility
  - Heavy ground cover and tree canopy
  - Project area very difficult to survey traditionally – Steep terrain & pits and physical hazards



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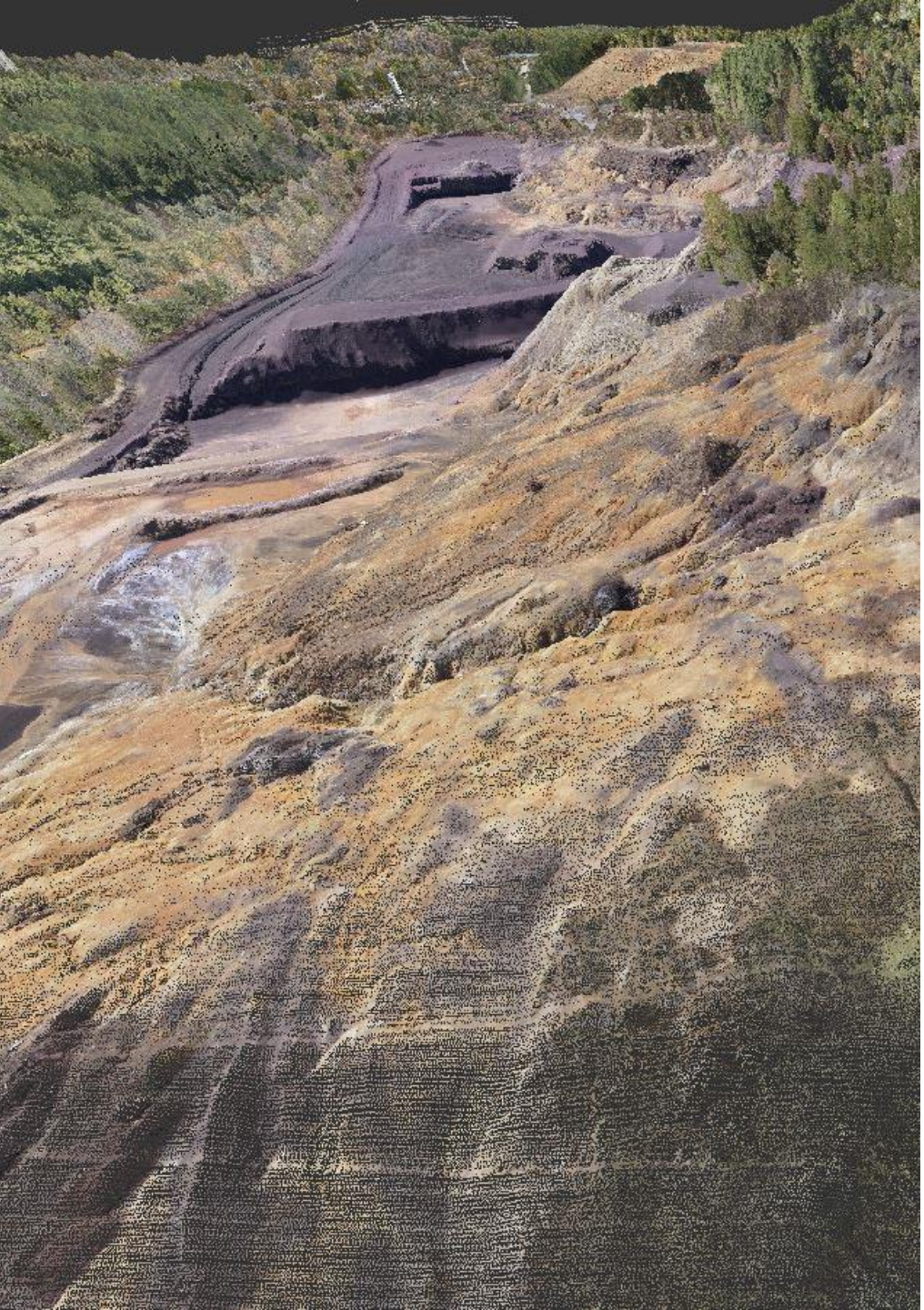
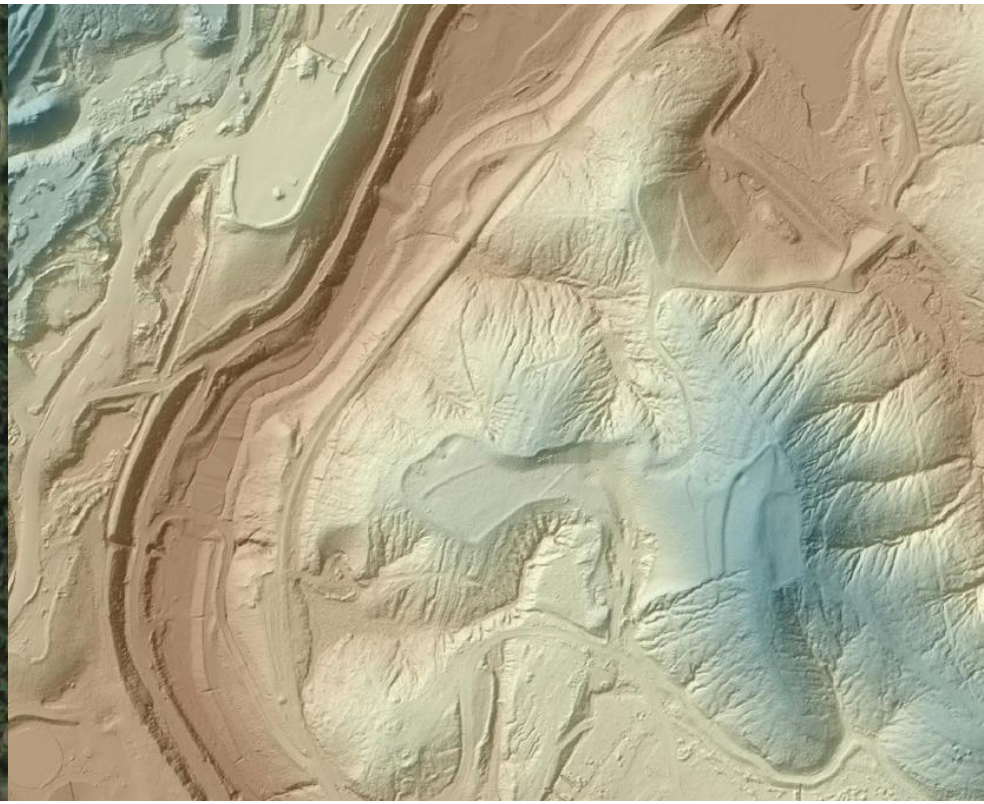
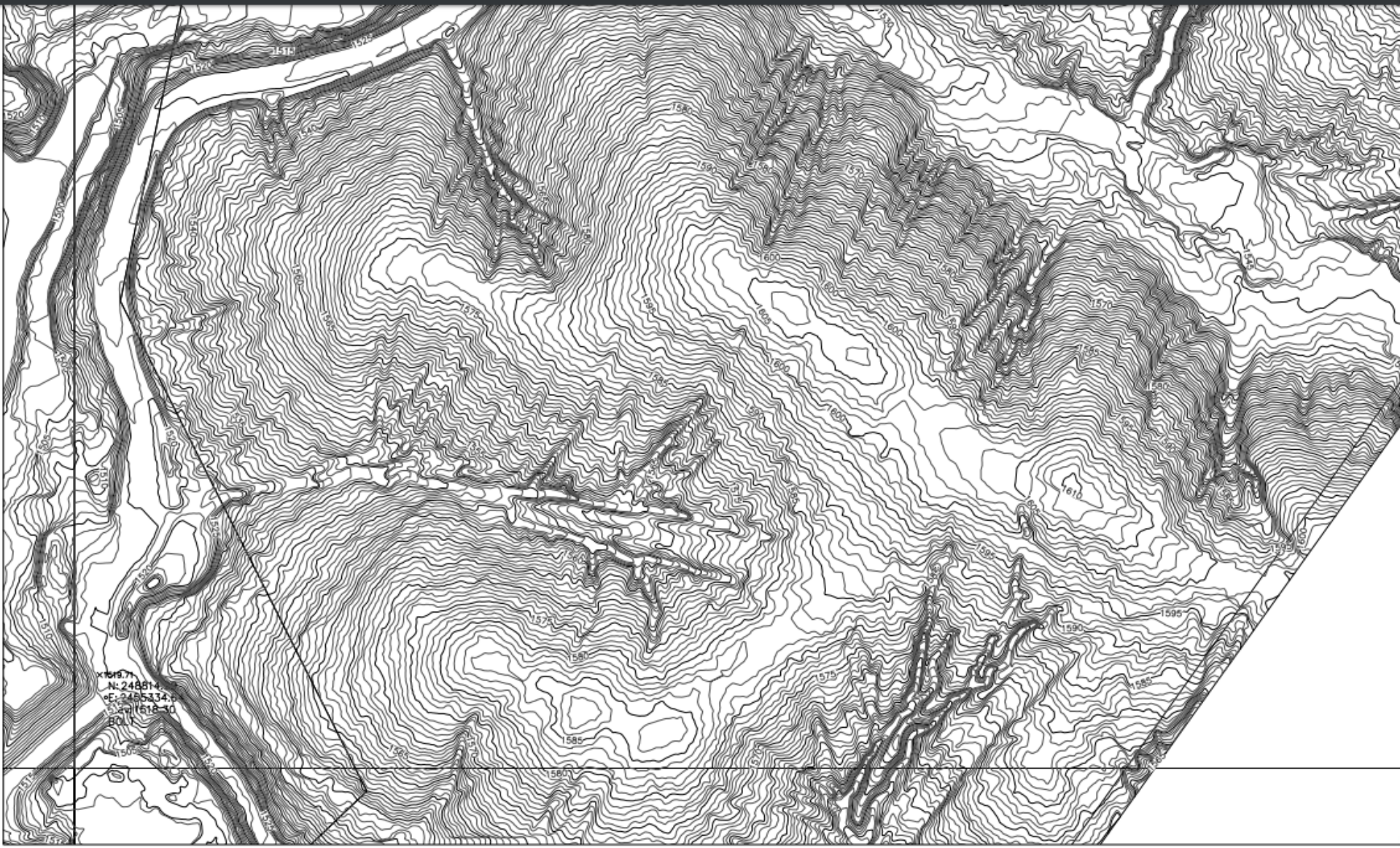


Example of Ground Cover

Terrain Surface Model Developed





COPPERHILL AERIAL SURVEY

e purpose of this survey was to map existing surface conditions.
rizontal Datum NAD 83(2011)
rtical Datum NAVD 88 Geoid 12B.
ordinates were established with survey grade dual frequency gps
ceivers.

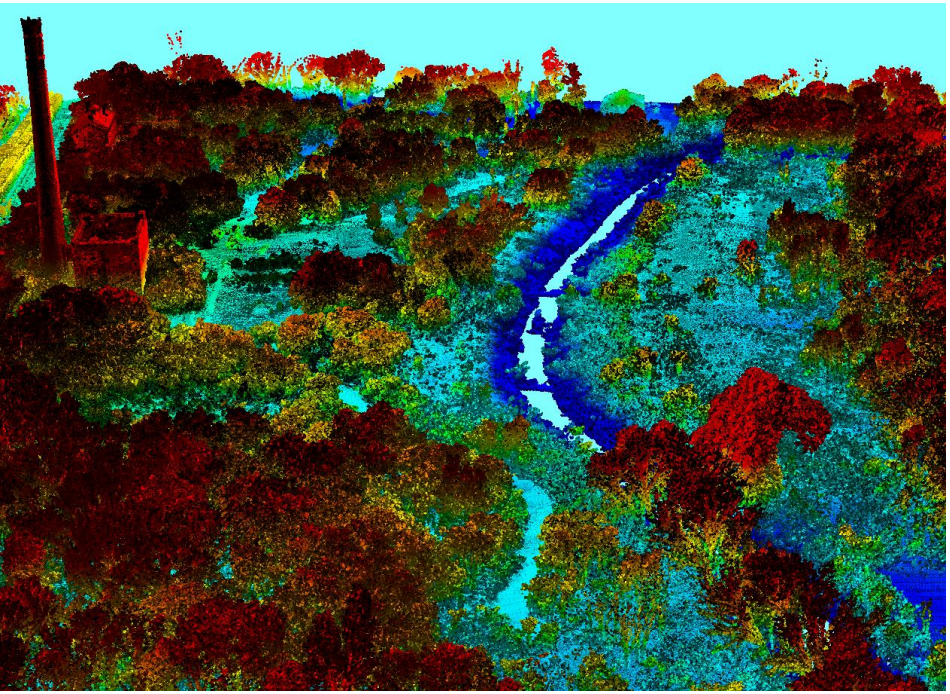
0 100 200
Feet

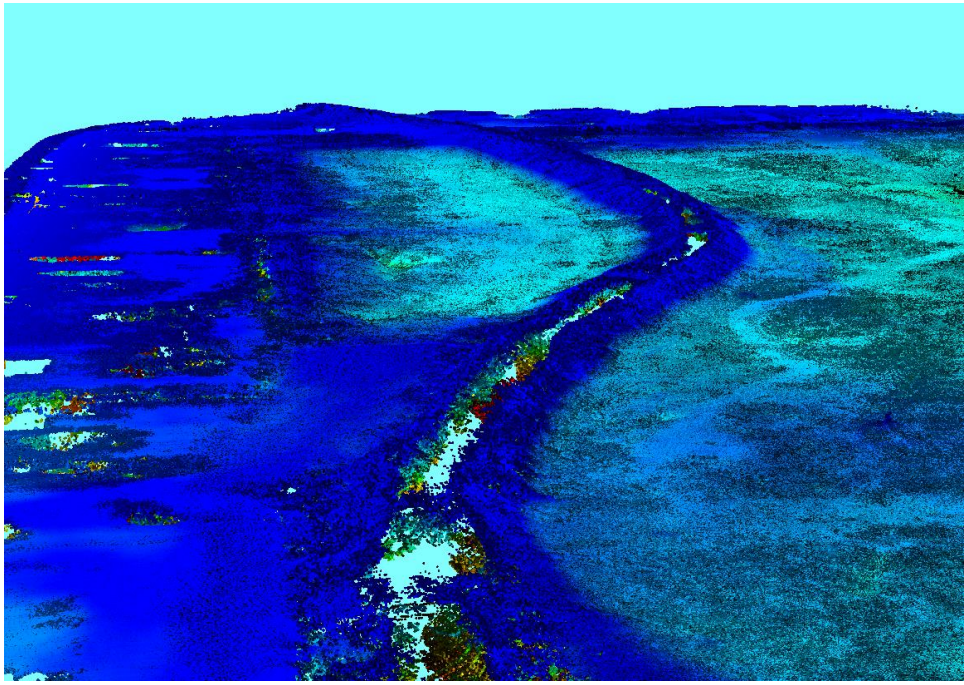
Subdivision: N/A			
SCALE 1"=100'		Plat Book: N/A	Page: N/A
Party Chief: DRY	Drawn By: AC	Checked By: DRY	
Revision	Job Number	Date	By:

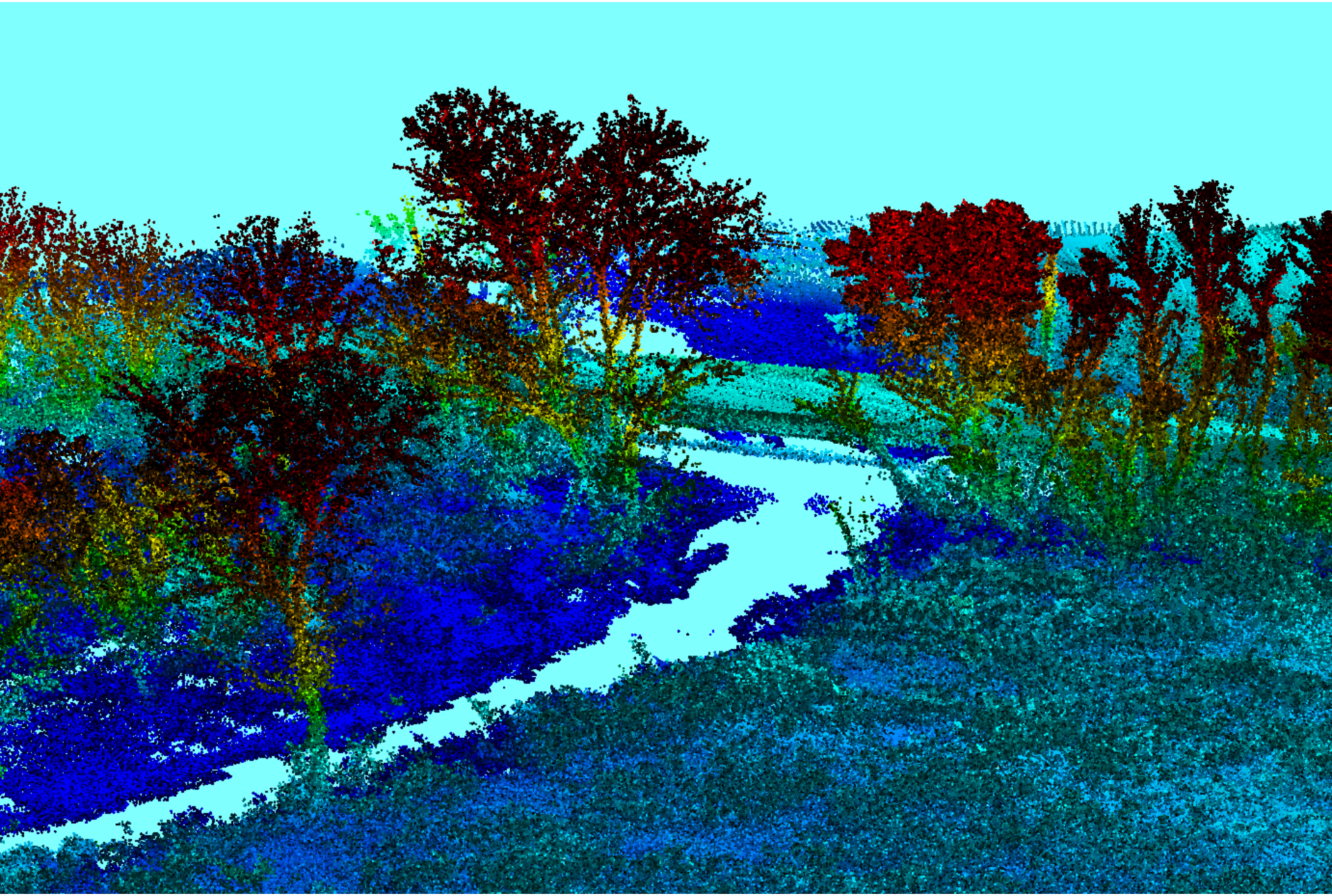
MAP OF TOPOGRAPHIC SURVEY

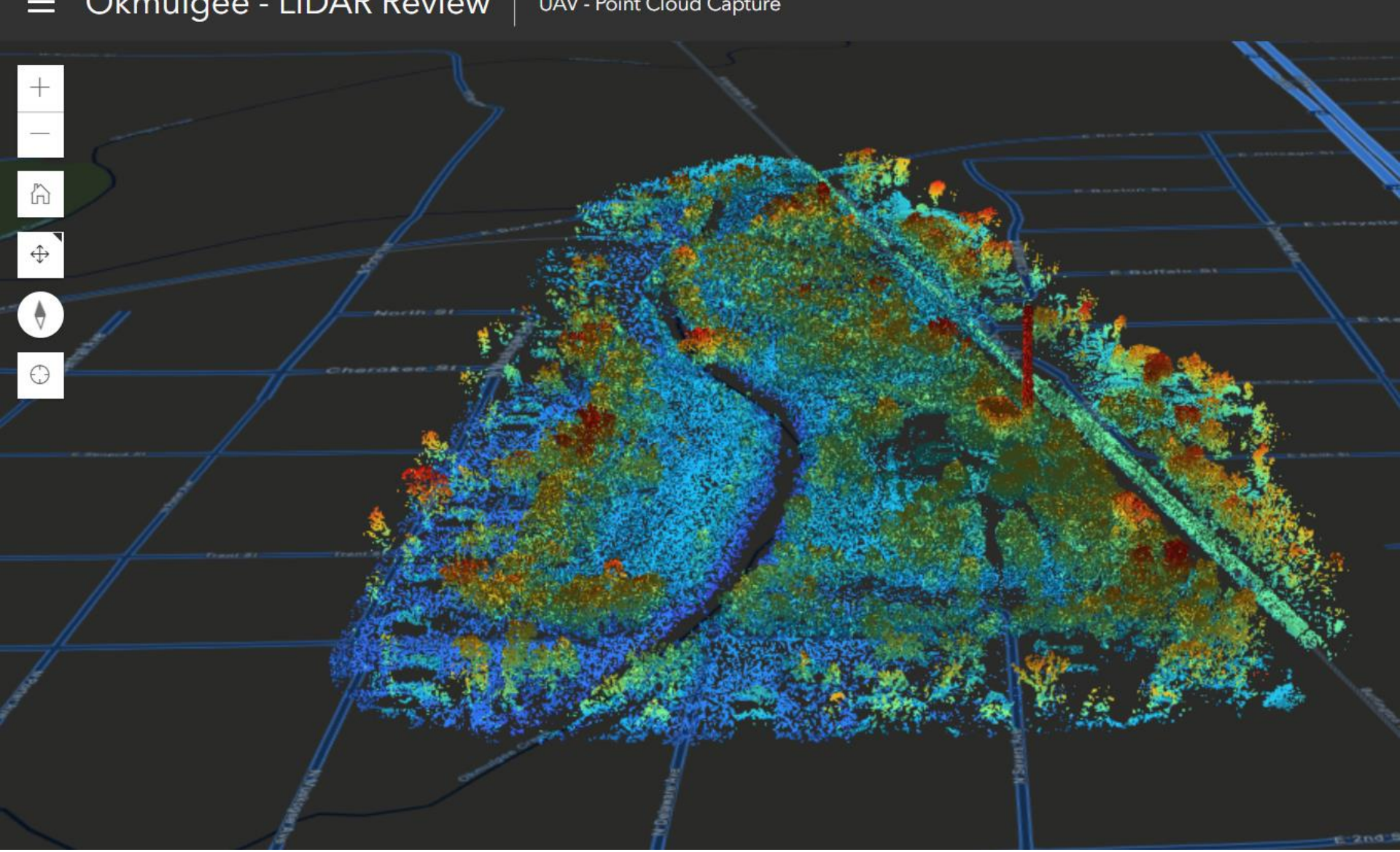
DAVID R. F. YOUNG
REGISTERED LAND SURVEYOR

DECL
Date









3D Scene viewer

THANK YOU

Andy Carroll

CTO

acarroll@skytecllc.com

877-485-0466 Ext. 2